

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (currently amended) A method of inspecting a defect in or on a semiconductor wafer, comprising:

directing a beam towards the surface of the semiconductor wafer wherein/whereon the defect resides to thereby emit X-rays;

detecting the emitted X-rays with plurality of detectors positioned at a plurality of angles with respect to the wafer surface;

collecting X-ray data from the detectors; and

~~using the X-ray data to spatially resolve the location of the defect with respect to the semiconductor wafer~~

based on the X-ray data collected from the detectors at the plurality of angles, determining a location of the defect in three dimensions in relation to a plurality of different process layers of the wafer.

2. (original) A method as recited in claim 1, wherein the detectors detect the emitted X-rays simultaneously.

3. (cancelled)

4. (original) A method as recited in claim 3, wherein the image is generated by combining the X-ray data from at least two X-ray emission energy spectra.

5. (original) A method as recited in claim 1, wherein the defect resides fully within a sample volume.

6. (original) A method as recited in claim 1, wherein the beam is stepped over an area where the defect resides.

7. (original) A method as recited in claim 6, wherein the beam is stepped in a grid configuration.

8. (original) A method as recited in claim 1, wherein the beam is rastered over an area where the defect resides.
9. (original) A method as recited in claim 1, wherein the directed beam is an electron beam.
10. (original) A method as recited in claim 1, wherein the directed beam is a focused ion beam.
11. (currently amended) A method as recited in claim 1, further comprising determining wherein the elemental composition of the defect is determined from based on the collected X-ray data.
12. (original) A method as recited in claim 1, wherein the semiconductor wafer comprises copper surrounded by dielectric material.
13. (original) A method as recited in claim 12, wherein the detected X-rays are at least copper $K\alpha$ and copper $L\alpha$ X-rays.
14. (original) A method as recited in claim 12, wherein the detected X-rays are at least copper $K\alpha$, copper $L\alpha$ and silicon $K\alpha$ X-rays.
15. (currently amended) A method of inspecting a defect in or on a semiconductor wafer, comprising:
- directing a beam towards the surface of the semiconductor wafer wherein/whereon the defect resides to thereby emit X-rays;
 - detecting the emitted X-rays with a detector at a first angle with respect to the wafer surface;
 - collecting X-ray data from the detector;
 - directing a beam towards the surface of the semiconductor wafer wherein/whereon the defect resides to thereby emit X-rays;
 - detecting the emitted X-rays with the detector at a second angle with respect to the wafer surface;
 - collecting X-ray data from the detector; and

~~using the X-ray data to spatially resolve the location of the defect with respect to the semiconductor wafer,~~

based on the X-ray data collected at the first and second angles, determining a location of the defect in three dimensions in relation to a plurality of different process layers of the wafer,

wherein the second angle of the detector with respect to the wafer surface is achieved by ~~performing an operation selected from a group consisting of~~ (i) moving the position of the detector to the second angle after collecting the X-ray data from the detector at the first angle ~~and~~ or (ii) tilting the wafer to achieve the second angle after collecting the X-ray data from the first angle.

16. (previously presented) A method as recited in claim 15, wherein the detector detects the emitted X-rays at the first and second angles at different sampling times.

17. (original) A method as recited in claim 15, wherein the detector detects emitted X-rays at a plurality of angles with respect to the wafer surface.

18. (original) A method as recited in claim 15, wherein the second angle of the detector with respect to the wafer surface is achieved by moving the position of the detector after collecting the X-ray data from the first angle.

19. (previously presented) A method as recited in claim 15, wherein the second angle of the detector with respect to the wafer surface is achieved by tilting the wafer after collecting the X-ray data from the first angle.

20. (original) A method as recited in claim 15, wherein using the X-ray data to spatially resolve the location of the defect is accomplished by generating an image based on the X-ray data.

21. (previously presented) A method as recited in claim 20, wherein the image is generated by combining the X-ray data from at least two X-ray emission energy spectra.

22. (original) A method as recited in claim 15, wherein the defect resides fully within a sample volume.

23. (original) A method as recited in claim 15, wherein the beam is stepped over an area where the defect resides.

24. (original) A method as recited in claim 23, wherein the beam is stepped in a grid configuration.

25. (original) A method as recited in claim 15, wherein the beam is rastered over an area where the defect resides.

26. (original) A method as recited in claim 15, wherein the directed beam is an electron beam.

27. (original) A method as recited in claim 15, wherein the directed beam is a focused ion beam.

28. (currently amended) A method as recited in claim 15, further comprising determining wherein the elemental composition of the defect is determined from the X-ray data collected at the first and second angles.

29. (original) A method as recited in claim 15, wherein the semiconductor wafer comprises copper surrounded by dielectric material.

30. (original) A method as recited in claim 29, wherein the detected X-rays are at least copper $K\alpha$ and copper $L\alpha$ X-rays.

31. (original) A method as recited in claim 29, wherein the detected X-rays are at least copper $K\alpha$, copper $L\alpha$ and silicon $K\alpha$ X-rays.

32. (currently amended) A method of inspecting a defect in or on a semiconductor wafer, comprising:

directing a beam towards the surface of the semiconductor wafer wherein/whereon the defect resides to thereby emit X-rays;

detecting the emitted X-rays substantially, simultaneously at a plurality of angles with respect to the wafer surface with a single detector;

collecting X-ray data from the detector; and

based on the collected X-ray data that is detected at the plurality of angles, determining a location of the defect in three dimensions in relation to a plurality of different process layers of the wafer.

~~using the X-ray data to spatially resolve the location of the defect with respect to the semiconductor wafer.~~

33-35.

36. (original) A method as recited in claim 35, wherein the image is generated by combining the X-ray data from at least two X-ray emission energy spectra.

37. (original) A method as recited in claim 32, wherein the defect resides fully within a sample volume.

38. (original) A method as recited in claim 32, wherein the beam is stepped over an area where the defect resides.

39. (original) A method as recited in claim 38, wherein the beam is stepped in a grid configuration.

40. (original) A method as recited in claim 32, wherein the beam is rastered over an area where the defect resides.

41. (original) A method as recited in claim 32, wherein the directed beam is an electron beam.

42. (original) A method as recited in claim 30, wherein the directed beam is a focused ion beam.

43. (currently amended) A method as recited in claim 30, further comprising determining ~~wherein~~ the elemental composition of the defect is ~~determined~~ from the collected X-ray data.

44. (original) A method as recited in claim 30, wherein the semiconductor wafer comprises copper surrounded by dielectric material.

45. (original) A method as recited in claim 44, wherein the detected X-rays are at least copper K α and copper L α X-rays.

46. (original) A method as recited in claim 44, wherein the detected X-rays are at least copper $K\alpha$, copper $L\alpha$ and silicon $K\alpha$ X-rays.

47. (currently amended) An apparatus for inspecting a defect in or on a semiconductor wafer, comprising:

a beam generator operable to direct a charged particle beam towards a structure;

a plurality of detectors positioned at different angles with respect to the surface of the semiconductor wafer to detect X-rays from the structure in response to the charged particle beam; and

a processor operable to:

cause the beam generator to direct a beam towards the structure; and

characterize one or more defects based on the detected X-rays from the plurality of detectors so as to spatially resolve a location of the one or more defects in three dimensions and in relation to a plurality of different process layers of the wafer.

48. (original) An apparatus as recited in claim 47, wherein the characterizing operation is based on a ratio of a first X-ray intensity for a first material over a second X-ray intensity for a second material, wherein the first and second X-ray intensities are obtained from the detected X-rays from the scanned structure.

49. (original) An apparatus as recited in claim 47, wherein the scanned structure is a portion of a interconnect structure in an integrated circuit device.

50. (original) An apparatus as recited in claim 47, wherein the directed beam is an electron beam.

51. (original) An apparatus as recited in claim 47, wherein the electron beam is stepped over an area of the sample surface.

52. (original) An apparatus as recited in claim 47, wherein the electron beam is rastered over an area of the sample surface.

53. (original) An apparatus as recited in claim 47, wherein the directed beam is a focused ion beam.

54-55. (cancelled)